

**CLAIMS**

I claim:

1. In a computer system with a spectral audio data encoder having an actual bit-rate feedback, uniform, scalar quantizer, a method for reducing the number of iterations of a quantization loop for a block of spectral audio data, the method comprising:

a) setting a polynomial that relates actual bit-rate to quantization threshold for spectral audio data in an actual bit-rate feedback, uniform, scalar quantizer, the initial coefficients for the polynomial set for typical spectral audio data;

b) calculating a candidate quantization threshold for a block of spectral audio data based upon the polynomial;

c) quantizing the block of data with the candidate quantization threshold;

d) measuring bit-rate of output following compression of the quantized block;

e) if the measured bit-rate falls within a pre-determined range below a target bit-rate, designating the candidate quantization threshold as final quantization threshold;

else adjusting one or more coefficients of the polynomial and repeating b) - e).

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2. A computer-readable medium storing instructions for a method of reducing the number of iterations of a quantization loop, the method comprising:

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a) setting a model that relates actual bit-rate to uniform, scalar quantization threshold for a data type in an actual bit-rate feedback quantizer;

b) calculating a candidate uniform, scalar quantization threshold for a block of input data based upon the model;

5 c) quantizing the block of input data with the candidate quantization threshold;

d) measuring bit-rate of output following compression of the quantized block;

e) if the measured bit-rate is acceptable, designating the candidate  
10 quantization threshold as final quantization threshold for the block of input data;  
else adjusting the model and repeating b) - e).

3. The computer-readable medium of claim 2 wherein initial parameters for the model are set for typical spectral audio data.

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4. The computer-readable medium of claim 2 wherein,  
calculating a candidate quantization threshold in a first iteration comprises

computing a first approximation  $T_1$  equal to  $\frac{|S|}{E_{TGT} - C_1 N}$ , wherein  $|S|$  is

cumulative spectral energy for the block,  $E_{TGT}$  is a target bit-rate,  $C_1$  is a first

20 coefficient, and  $N$  is the number of points of input data in the block,

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calculating a candidate quantization threshold in a second iteration

comprises computing a second approximation  $T_2$  equal to  $\frac{T_1 E(S, T_1)}{E_{TGT}}$ , where

$E(S, T_1)$  is the measured bit-rate of the first iteration, and

calculating a candidate quantization threshold in subsequent iterations

5 comprises computing a subsequent approximation  $T_k$  equal to  $\frac{C_2 |S|}{E_{TGT} - C_1 N}$ ,

wherein  $C_2$  is a second coefficient, and  $C_1$  and  $C_2$  reflect the results of previous iterations.

5. The computer-readable medium of claim 2 wherein the measured  
10 bit-rate is acceptable if the measured bit-rate lies within a predetermined range around a target bit-rate.

6. The computer-readable medium of claim 2 wherein the measured  
bit-rate is acceptable if the measured bit-rate lies within a predetermined range  
15 around a target bit-rate or if the output with the measured bit-rate has less than a predetermined target distortion.

7. A computer-readable medium storing instructions for a method of  
dequantizing the block of input data quantized according to the method of claim  
20 2, the method comprising:

receiving the block of input data; and

applying the final quantization threshold to the block of input data in  
inverse quantization.

8. In a computer system with an encoder having a quantizer, a method  
5 for finding a quantization threshold using a quantization loop with a heuristic  
approach, the method comprising:

estimating a quantization threshold based upon a heuristic model of actual  
bit-rate versus quantization threshold, wherein the model adjusts responsive to  
negative evaluation of an acceptability criterion for the estimated quantization  
10 threshold;

evaluating whether bit-rate of compressed output quantized by the  
estimated quantization threshold satisfies the acceptability criterion and if so,  
designating the estimated quantization threshold as final quantization threshold,  
and if not, adjusting the model and repeating the estimating and evaluating.

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9. The method of claim 8 wherein the quantization threshold is a  
uniform, scalar quantization threshold.

10. The method of claim 8 wherein the model is initially parameterized  
20 for typical spectral audio data.

11. The method of claim 8 wherein estimating a quantization threshold  
in a first iteration comprises computing a first approximation  $T_1$  equal to

$\frac{|S|}{E_{TGT} - C_1 N}$ , wherein  $|S|$  is cumulative spectral energy for a block of data,  $E_{TGT}$

is a target bit-rate,  $C_1$  is a first non-zero coefficient, and  $N$  is the number of points of data in the block.

- 5            12. The method of claim 11 wherein estimating a quantization threshold in a second iteration comprises computing a second approximation  $T_2$  equal to

$$\frac{T_1 E(S, T_1)}{E_{TGT}}, \text{ where } E(S, T_1) \text{ is the bit-rate of compressed output from the first}$$

iteration.

- 10            13. The method of claim 12 wherein estimating a quantization threshold in a subsequent iteration comprises computing a subsequent approximation  $T_k$

$$\text{equal to } \frac{C_2 |S|}{E_{TGT} - C_1 N}, \text{ wherein } C_2 \text{ is a second non-zero coefficient, and } C_1 \text{ and}$$

$C_2$  reflect the results of previous iterations.

- 15            14. The method of claim 8 wherein the acceptability criterion comprises proximity of the evaluated bit-rate to a target-bit-rate.

15. The method of claim 14 wherein the acceptability criterion further comprises satisfaction of a minimum logarithmic distance threshold between  
20 quantization thresholds in successive iterations.

16. A method of dequantizing compressed output quantized by the estimated quantization threshold designated as the final quantization threshold according to the method of claim 8, the method comprising:

- 5 receiving the compressed output;
- decompressing the compressed output; and
- applying the final quantization threshold to the decompressed output in an inverse quantization operation.

- 10 17. In a computer system, a bit-rate feedback quantizer comprising:
- a threshold estimator for estimating a quantization threshold based upon a model of actual bit-rate versus quantization threshold, wherein the threshold estimator adjusts the model responsive to a negative evaluation of an acceptability criterion for the quantization threshold;

- 15 a threshold evaluator for evaluating actual bit-rate of output following compression, the threshold evaluator further evaluating whether the estimated quantization threshold satisfies the acceptability criterion.

18. The quantizer of claim 17 wherein the threshold estimator adjusts
- 20 parameters of the model initially set according to data type.

19. The quantizer of claim 18 wherein the data type is spectral audio data.

20. The quantizer of claim 17 wherein the acceptability criterion comprises proximity of the actual bit-rate to a target-bit-rate.

5 21. The quantizer of claim 17 wherein the quantization threshold is a uniform, scalar quantization threshold.

22. A computer-readable medium storing instructions for a bit-rate feedback quantizer with a heuristic approach, the quantizer comprising:

10 means for estimating a quantization threshold based upon a heuristic model of actual bit-rate as a function of quantization threshold, wherein the means for estimating adjusts one or more parameters of the model responsive to a negative evaluation of acceptability of the estimated quantization threshold;

means for evaluating actual bit-rate following compression of output  
15 quantized by the estimated quantization threshold, wherein the means for evaluating further evaluates the acceptability of the estimated quantization threshold.

23. A computer-readable medium storing instructions for a method of  
20 dequantizing a block of input data quantized in a bit-rate feedback quantizer with a heuristic approach, the method comprising:

receiving a block of quantized input data, the input data quantized by a bit-rate feedback quantizer with a heuristic approach; the quantizer including a

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threshold estimator and a threshold evaluator, the threshold estimator for estimating a quantization threshold based upon a heuristic model of actual bit-rate versus quantization threshold, wherein the threshold estimator adjusts the model responsive to a negative evaluation of an acceptability criterion for the estimated

- 5 quantization threshold, the threshold evaluator for evaluating actual bit-rate following compression of output quantized by the estimated quantization threshold, wherein the threshold evaluator further evaluates whether the estimated quantization threshold satisfies the acceptability criterion; and

applying the final quantization threshold to the block of quantized input

- 10 data in inverse quantization.